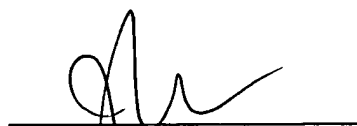


REMARKS

The amendments are submitted to correct minor typographical errors in the specification.

Respectfully submitted,

A handwritten signature in black ink, appearing to be 'John T. Lucas', written over a horizontal line.

John T. Lucas, Reg. No. 36860  
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Date: February 8, 2006

AMENDED SPECIFICATION TEXT  
INCORPORATING AMENDMENTS IN RESPONSE TO  
NOTICE OF ALLOWANCE DATED December 2, 2005  
FOR SERIAL NO. 10/663,052

The following is a marked-up version of the amended specification for the 312 Amendment after Allowance, showing the changes to the specification.

IN THE SPECIFICATION:

In paragraph 0005 on page 3.

**[0005]** There has been little progress in removing of mercury from high temperature gas streams. As such, nearly all of the mercury in the coal ends up in the flue gases (~1 part per billion (ppb) concentration) and fuel gases (~3 ppb concentration). Many sorbents' capacities for the adsorption of mercury is are limited as shown in Table 1 *infra*.

In paragraph 0028 on page 7.

**[0028]** The benefits of high temperature (205°C – 370°C (400°F -700°F)) mercury removal ~~include~~ includes the ability to utilize warm gas cleanup methods which already exist for scrubbing hydrogen sulfide (H<sub>2</sub>S) from the effluent gases. This supercedes typical methods which require cooling the effluent gases in order to scrub hydrogen sulfide. Thus, thermal energy efficiency is enhanced. Also enhanced is the capability of removing a vast majority of the coal-inlet mercury at one location, compared to the present systems where not all of the mercury is accounted for.

Paragraph 0041 page 10.

**[0041]** The invented process and sorbent ~~provides~~ provide a two-step mechanism to capture mercury. The mechanism employs both surface adsorption, as well as the formation of a solid

solution (an amalgam, i. e., an alloy of mercury with another metal, formed by mercury penetrating the metal lattice). A metal sorbent on a substrate's surface is depicted in FIG. 2 as numeral 50. The substrate 52 has finely divided metal 54 adsorbed to the substrate's surface. This metal film facilitates both adsorption and amalgam mechanisms.

Paragraphs 0051 and 0052 starting at the bottom of page 11.

[0051] Table 2 *infra* summarizes the effect of temperature on iridium's mercury absorption capacity.

~~Table 2. Mercury absorption capacity of iridium as a function of temperature<sup>a</sup>.~~

Table 2. Mercury Absorption Capacity of Iridium as a Function of Temperature<sup>a</sup>.

<u>Sorbent</u>	<u>Capacity (mg/g)</u>	<u>Temp (°F)</u>
Ir	2.11	400
Ir	2.69	450
Ir	2.90	500

<sup>a</sup>Conditions were:

- 1) Ten mg Ir black (pure) (Aldrich Chemical Company, Milwaukee, WI); surface area of 20 m<sup>2</sup>/g.
- 2) Hg concentration 270 ppb in N<sub>2</sub> carrier gas.
- 3) Hg measurement by cold vapor atomic absorption spectrophotometer (CVAAS) of absorbent at test end.

[0052] Table 3 *infra* gives results for the percent of mercury capture by iridium. Mercury capture is defined as the mass of mercury contained in the sorbent after use divided by the mass of mercury that passes through the bed, typically in 350 minutes (mins).

~~Table 3. Mercury Capture by Iridium as a function of temperature and exposure time<sup>a</sup>~~Table 3. Mercury Capture by Iridium as a Function of Temperature and Exposure Time<sup>a</sup>

<u>Temperature (°C (°F))</u>	<u>Time Exposed (min)</u>	<u>% Mercury Captured by Iridium Sorbent</u>
246 (475)	425	96
287 (550)	350	93
329 (625)	350	60
371 (700)	350	40

<sup>a</sup>Conditions were

- 1) Ten mg Ir sorbent in packed-bed.
- 2) 270 ppb Hg in N<sub>2</sub> with a flow rate of 60 ml/min.
- 3) Adsorbed Hg measured by an on-line BrooksRand CVAFS-2 atomic fluorescence spectrophotometer (AFS), (BrooksRand, Seattle, WA).
- 4) Maximum capacity (100% Hg capture) determined to be 5.5 mg Hg/gram sorbent for an exposure time of 350 minutes (mins).

Paragraphs [0054] and [0055] starting at the bottom of page13.

**[0054]** Similar tests on palladium, platinum, and ruthenium as sorbents of Group IIB (12) elements were carried out. Each sorbent metal was tested using separately two different gases: 1) 270 ppb mercury in otherwise pure nitrogen gas, and 2) a simulated fuel gas or syngas with a composition of: 36 % (mol) carbon monoxide (CO), 27 % hydrogen (H<sub>2</sub>), 270 ppb mercury (Hg), and the remainder nitrogen gas. Ten mg of each metal sorbent were placed in a vertical packed-bed reactor *supra*, and exposed to the mercury in either the nitrogen gas or the simulated syngas for 350 minutes. The results for these tests are given in Table 4 *infra*.

~~Table 4. Mercury capture (%) by palladium, platinum, and  
ruthenium as a function of temperature<sup>a</sup>.~~

Table 4. Mercury Capture (%) by Palladium, Platinum, and Ruthenium as a Function of Temperature<sup>a</sup>.

Metal	205°C(400°F)	290°C(550°F)	370°C(700°F)
Pd	58	100	35
Pt	-	65	-
Ru	60	65	36

<sup>a</sup>Conditions were:

- 1) For each trial, the sorbent was 10 mg of pure metal in a vertical packed-bed configuration. The palladium (Alfa Aesar, Ward Hill, MA) was 99.95% pure, particle size of 1 micron ( $\mu$ ), and had a surface area of 1 m<sup>2</sup>/g. The platinum (Alfa Aesar, Ward Hill, MA) was platinum black (pure) with a surface area of 27 m<sup>2</sup>/g. The ruthenium (Engelhard, East Newark, NJ) and was 5% Ru on char (carbon support).
- 2) Hg concentration 270 ppb in N<sub>2</sub> carrier gas. Flow rate was 60ml/min.
- 3) Hg measurement by cold vapor atomic absorption spectrophotometer (CVAAS) or by AFS as mentioned *supra*.
- 4) Maximum capacity (100% Hg capture) determined to be 5.5 mg Hg/gram sorbent for an exposure time of 350 minutes (mins).

**[0055]** Clearly, these three active metals display a considerable capacity for mercury adsorption up to at least 290°C(550°F). In addition, tests were carried out on all four active metals using a simulated fuel gas having the composition: 36 mol % CO, 27 mol % H<sub>2</sub>, 270 ppb Hg, and the balance N<sub>2</sub>. The simulated fuel gas flow rate was 60 ml/min. Pure active metal was used as the sorbent in the amount of 10 mg in a packed-bed configuration. The results are given in Table 5 *infra*. The data in Table 5 demonstrates that palladium and platinum are good absorbers of mercury found in fuel gases with platinum having a 100% capture capability.

Table 5. Mercury Capture (%) from Simulated Fuel Gas by Iridium, Palladium, Platinum and Ruthenium as a Function of Temperature<sup>a</sup>.

~~Table 5. Mercury capture (%) from simulated fuel gas by iridium, palladium, platinum, and~~

ruthenium as a function of temperature<sup>a</sup>:

Metal	290°C(550°F)
Pt	100
Pd	76
Ir	3
Ru	1

<sup>a</sup>Conditions were:

- 1) For each trial, the sorbent was 10 mg of metal sorbent in a vertical packed-bed configuration. The specifications of the iridium are described in Table 2 *supra* and for the three other metals in Table 4 *supra*.
- 2) Gas was 36 mol % CO, 27 mol % H<sub>2</sub>, 270 ppb Hg, balance N<sub>2</sub>. Flow rate was 60ml/min.
- 3) Hg measurement by cold vapor atomic absorption spectrophotometer (CVAAS).
- 4) Maximum capacity (100% Hg capture) determined to be 5.5 mg Hg/gram sorbent for an exposure time of 350 minutes (mins).